15-17 are amended. Support for the Amendment of the specification can be found, for example, in claim 13 as originally filed; at page 26, line 15; at page 43, Table 7. Support for the amendment of claims 13 and 15-17 can be found in the specification, for example, at page 2, lines 17, and from page 23, line 20 to page 24, line 3. Thus, this amendment does not introduce new matter.

The attached Appendix includes marked-up copies of each rewritten paragraph (37 C.F.R. §1.121(b)(1)(iii)) and claim (37 C.F.R. §1.121(c)(1)(ii)).

Applicants thank the Examiner for the indication that claims 1-6 and 12 are allowable over the prior art, that claim 11 is only objected to as being dependent on a rejected claim, and that claims 13 and 15-17 would be allowable if the rejection under 35 U.S.C. §112, second paragraph, is overcome.

For all of the reasons set forth below, all of claims 1-20 are believed to be in condition for allowance.

I. <u>Objections to the Specification</u>

The Office Action objects to the specification for various informalities. Applicants have amended the specification to correct the informalities identified in the Office Action.

A. Wax C, D and E

The Office Action objects to Examples 6 and 7 and Comparative Examples 4, 5 and 7 for including either WAX D or WAX E, alleging that theses waxes are not specifically identified in the specification. Applicants respectfully submit that WAX D and WAX E are described in the specification. However, due to a typographical error in the Table in which WAX D and WAX E are described, the waxes are incorrectly designated. As amended, Table 6, at page 39, correctly designates the waxes as WAX C, WAX D and WAX E.

The March 7, 2003 Advisory Action indicated that such an amendment raises the issue of new matter, stating that there is no evidence in the originally filed specification

showing that waxes C, D and E have the composition as disclosed in amended Table 6. Applicants respectfully traverse the objection and maintain the position that in Examples 4-7 and Comparative Examples 4-7, wax C, D and E are mistakenly identified in Table 6 as wax A, B and C respectively. Applicants further submit that the amendment to Table 6 does not contain new matter. Applicants provide the following evidence in support of their position.

First, Applicants maintain that the amendment to Table 6 would provide all of the necessary description to waxes C-E in Examples 4-7 and Comparative Examples 4-7 and would thus overcome the Office Action objection. The Advisory Action does not indicate otherwise. Thus, the issue is whether such an amendment constitutes new matter.

At page 19, the specification discloses the preferred wax. In particular, wax having a melt viscosity of from 1 to 100 mPa·s at 110 °C are most preferred. As detailed in the specification, when the melt viscosity of the wax is too high, the eluation of the wax from the toner is weak and the fix releasing property is insufficient.

As indicated at pages 41-42 of the specification, Comparative Example 7 (CE 7) includes wax E. As further described at page 46, Applicants observe that in CE 7, because the "melt viscosity of the wax is too high, ... the OHP transparency and the low temperature fixing property cannot be satisfied." The specification expressly states that CE 7 includes a wax outside the preferred melt viscosity range.

Based upon the disclosed preference for wax having melt viscosity lower than 100 mPa·s, CE 7 must include a wax with a melt viscosity above this value. Referring again to Table 6 (as originally filed), wax C (Heptatriacontanole oxalate) has a melt viscosity of 150 mPa·s, clearly above the preferred value of 100 mPa·s. Thus, the combined evidence of the disclosed preferred melt viscosity values, the predicted consequences of including wax above the preferred melt viscosity, and the data characterizing CE 7, supports Applicants' contention that wax C in Table 6 actually refers to wax E in CE 7.

Furthermore, according to the specification at pages 39-40, Examples 4-7 include either wax C or wax D. In contrast to CE 7, as described at pages 44-45 and in Tables 7 & 8, Examples 4-7 satisfy the low temperature fixing property, the anti-offset property and the OHP transparency requirements. One would therefore conclude that Examples 4-7 contain a preferred wax. As shown in Table 6, wax A and wax B both satisfy the requirements for a preferred wax, specifically, melting point and melt viscosity. Thus, Examples 4-7 could contain wax A or B, described in Table 6. The evidence does not point away from such a conclusion. It is Applicants' position that wax A and B in Table 6 are respectively the same as wax C and D, in Examples 4-7.

Finally, according to the specification at pages 40-41, Comparative Examples 4, 5 and 6 (CE 4-6) also include wax C or D. In contrast to Examples 4-7, however, CE 4-6 fail to provide a satisfactory toner and it is important to understand why. The specification discloses, at pages 45-46, that:

- in CE 4 the differential molecular weight distribution value is larger than 0.55% and so the anti-offset property cannot be satisfied;
- in CE 5 the low-temperature fixing property is unsatisfactory, the OHP property is not sufficient, SF-1 and SF-2 are unsatisfactory and so the transferring property of the toner is insufficient; and
- in CE 6 the molecular weight is distributed in the range of greater than 1 x 10^6, the value of the differential molecular weight distribution is larger than 0.15, the OHP transparency is insufficient and the low-temperature fixing property cannot be satisfied.

Of particular note, however, is that the failings of CE 4-6 do not appear to be due to the type of wax used in the toner composition. In contrast to CE 7, the specification does not mention that CE 4-6 fail to provide a satisfactory toner because of the type of wax, or because

the melt viscosity of the wax is too high. Accordingly, one can construe that CE 4-6, each including either wax C or D, contain a preferred wax; the specification does not indicate otherwise. Applicants point this out as additional evidence to support their contention that wax A and B in Table 6 (preferred waxes) refer to wax C and D in Examples 4-7 and Comparative Examples 4-6, and that wax C in Table 6 (non-preferred wax) refers to wax E in CE 7.

Applicants contend that Table 6 is mislabeled and consequently, the waxes are incorrectly identified. As shown in the Amendment, Wax A, B and C should be labeled as Wax C, D and E.

In addition to the above evidence, Applicants provide further reasons to support their position. Analogous to Table 6, Table 2 lists the characteristics of Wax A and Wax B. Following Table 2, beginning at page 29, the specification discloses several toner mixture Examples and Comparative Examples that include wax A or B. Just like CE 7, CE 2 also includes a non-preferred wax (Wax B from Table 2). Interestingly, CE 2 results in a toner composition with characteristics similar to CE 7, namely, that because "the melt viscosity of the wax is high ... the IHP transparency is insufficient and the low-temperature fixing property cannot be satisfied." Again, the specification shows that wax B in CE 2 and Table 2, and wax E in CE 7 and amended Table 6, are both non-preferred waxes with high melt viscosity. Thus, just as wax B in Table 2 describes wax B in CE 2, wax C in original Table 6 describes wax E in CE 7.

As noted above, following Table 2, the specification immediately discloses the preparation of Example and Comparative Example toner compositions, the analysis of the integral molecular weight distribution and SF-1/SF-2 of each toner (Table 3), the preparation of developer, and the evaluation of its properties (Tables 4 and 5). The specification follows an identical pattern after Table 6, immediately disclosing the preparation of Example and

Comparative Example toner compositions, the analysis of the integral molecular weight distribution and SF-1/SF-2 of each toner (Table 7), the preparation of developer, and the evaluation of its properties (Table 8). Accordingly, because Examples 4-7 and Comparative Examples 4-6 indicate toners mixtures including wax C, D or E, it is evident that the waxes listed in Table 6 as A, B and C are mislabeled.

Finally, Table 2 lists waxes A and B. Logically, Table 6 should then pick up where Table 2 left off, and list waxes C, D and E. The Examples and Comparative Examples described in the specification support this logic.

In view of the supporting evidence and remarks set forth above, Applicants respectfully submit that Table 6 as originally filed is mislabeled, the amendment to Table 6 correctly lists the waxes, and that the amendment does not introduce new matter.

Accordingly, Applicants respectfully request reconsideration and withdrawal of this aspect of the objection.

B. Asker C hardness

The Office Action objects to the specification as allegedly omitting essential subject matter that is necessary to describe and enable the claimed invention. In particular, the Office Action alleges that the specification lacks any indication as to how the Asker C values for rubber hardness of a pressure roller and a heat roller are determined. The Office Action concludes that the disclosure is inadequate to inform one skilled in the art how to make and use the claimed invention.

Applicants respectfully disagree with this contention. One of ordinary skill in the relevant art would have understood the described Asker C values, what they measure, and how the measurements are taken. Moreover, one of ordinary skill would have been able to repeat the rubber hardness measurements of a pressure roller and a heat roller as described in the specification.

Beginning at page 23, the specification discloses an image forming process embodied by the invention. This embodiment includes a fixing step of fixing the transfer image using a heat roller and a press roller. The surfaces of the rollers preferably include an elastic layer and a surface layer. The specification further describes the importance of providing rollers with defined rubber hardness, and at page 24, the specification discloses a preferred rubber hardness. The specification quantifies hardness in "degrees by Asker C." One of ordinary skill in the art would immediately recognize these rubber hardness values.

The Asker Durometer manuals (copies enclosed) demonstrate what is meant by Asker C values. The Asker company manufactures a variety of rubber hardness testers. As indicated at page 2 of the manual labeled "Hardness Tester for Rubber and Plastics," there are various types of rubber hardness testers available, based upon different standards as applied to a variety of subjects to be measured. Popular models for testing rubber materials include the Type A Durometer (Asker Model A) and Type A Hardness Tester (Asker Model JA). Other typical models include the Asker Model D for hard rubber and the Asker Model C for soft rubber.

As described at page 2 of the "Rubber Hardness Tester (Durometer) Instruction Manual," the Asker testers are designed to measure the hardness of a test specimen from the "depth of penetration" of the indentor in a state of balance between the resistance force of the specimen and the force of a spring when the indentor is pressed to the surface of the specimen (see, Fig. a-c). The hardness tester is equipped with an indicating mechanism that reads the depth of penetration according to a scale graduating from 0 to 100 degrees (see, photos of Asker Model gauges at pages 2-4).

As explained in the instruction manual, to measure hardness, one simply holds the tester perpendicularly with both hands, presses the pressor foot (the surface from which the indentor extends) of the tester to the surface of the test specimen and reads the position of the

pointer on the scale plate. The instruction manual provides further suggestions to ensure accurate measurements (see, page 2, item 2).

In view of the Asker manuals and the above comments, the specification's disclosure of hardness measured in terms of "degrees by Asker C" would have been clear to one of ordinary skill in the art. Using the Asker Model C Durometer, one would determine the rubber hardness levels of the heat roller and press roller as indicated by the instructions. Measurements between 0 and 100 degrees are read from the graduated scale and recorded as "degrees by Asker C."

As stated in the manual, and pointed out in the Advisory Action, "[o]ne of the most important steps in using a rubber hardness tester is to select the optimum type. There are various types of rubber hardness testers available based on different standards applied to a wide variety of subjects to be measured." Applicants do not disagree with this statement in the manual. Moreover, one of ordinary skill in the art would recognize the importance of selecting the appropriate hardness tester. Therefore, Applicants teach the correct type of hardness tester to use, i.e., the Asker Model C.

The Advisory Action notes the Asker instruction manual's statement that "[e]xpression of hardness is often specified by relative standards." That may very well be true but in the instant case, that point is irrelevant. One of ordinary skill in the art would appreciate that the art applies more than one standard to determine hardness values. However, the specification is clear in its definition of hardness in "degrees by Asker C." The Asker C values stated in the specification come from measurements taken directly off the Asker Model C Durometer gauge.

The Advisory Action points to the instruction manual at page 2, item 2.2, and concludes that measurement of a hardness value depends on the load applied. However, Applicants respectfully believe that this conclusion is misdirected. As mentioned above, the

instruction manual presents the user with information to improve the measurement accuracy. Item 2.2 provides such additional guidance to ensure that the measurements taken with the Asker testers are accurate. The instruction manual specifies the correct amount of force to apply (1 to 1.5 kg), tells the user to maintain uniform contact with the sample surface, and cautions the user not to use excessive force when measuring soft specimens. Therefore, contrary to the Advisory Action's understanding, the dependence of hardness values on the applied load force only extends to the point that the proper force must be applied. As detailed in the Asker instruction manual, applying the correct force and taking accurate hardness level measurements is well within the talent of one of ordinary skill in the art.

In view of the above comments, the disclosure in the specification does provide sufficient guidance to a person having ordinary skill in the art to make or use the claimed invention without undue experimentation. Accordingly, Applicants respectfully request reconsideration and withdrawal of this aspect of the objections.

C. Additional objections

The Office Action notes that the specification, at page 45, line 24, and at page 46, line 7, reciting that the differential molecular weight of 1×10^6 is larger than 0.15%, appears to contradict the differential molecular weight of 1×10^5, indicated in the Examples in Table 7 on page 43. Applicants amend the specification to indicate that regarding Comparative Examples 6 and 7, the differential molecular weight of 1×10^5 is larger than 0.15%, consistent with Examples 4-7 and Comparative Examples 4-5, disclosed at pages 44-45, and in agreement with Table 7.

The Office Action observes that the specification, at page 8, line 10, states that the toner image has a glossiness of from 40 to 50, while at page 26, line 15, the specification indicates that the fixed image has a glossiness of from 40 to 60. The amended specification indicates that the glossiness has a range from 40 to 60 with a preferred range of 40 to 50.

The Office Action also objects to the specification as allegedly failing to provide proper antecedent basis for the subject matter of claim 13. In particular, the Office Action states that claim 13 specifies a "fixing apparatus" and "releasing resin," and alleges that both are broader than the disclosed examples in the specification. The amended specification recites a fixing apparatus and releasing resin at pages 7 and 24.

In view of the foregoing amendments and comments, Applicants respectfully request reconsideration and withdrawal of the objection.

II. Rejection under §112, Second Paragraph

The Office Action rejects claims 13 and 15-19 as allegedly indefinite under 35 U.S.C. §112, second paragraph. Applicants respectfully traverse this rejection.

Amended claim 13 indicates that the fixing apparatus comprises at least one roller and that a surface layer of the at least one roller comprises a releasing resin. Amended claim 13 also indicates that the surface layer of the least one roller is supplied with substantially no releasing liquid.

Amended claim 15 indicates that the toner image is formed on the transfer material and that the 0.50 mg/cm^2 amount of toner image refers to that before fixing.

Amended claim 13 defines dependent claims 16-19. In particular, the "fixing apparatus comprising at least one roller" recited in claim 13 clarifies that at least one of "a heat roller and a pressure roller" recited in claims 16-18 comprises a releasing resin, and that in claim 19, the surface layer of the heat roller and/or pressure roller comprises the releasing resin.

Claims 13 and 15-19 clearly indicate the structural features of the claimed invention, and claim 13 provides proper antecedent support for all of the features in dependent claim 15. As such, claims 13 and 15-19 satisfy the requirements of 35 U.S.C. §112, second paragraph.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection.

III. <u>Rejection under §112, First Paragraph</u>

The Office Action rejects claims 18 and 19 under 35 U.S.C. §112, first paragraph, as allegedly not enabled by the specification. Applicants respectfully traverse this rejection.

The specification fully enables claim 18 and 19. As detailed in the above remarks regarding the objection to the specification and the issue of Asker C hardness, one of ordinary skill in the relevant art would know the method by which the Asker C value was determined and would know how to obtain hardness measurements expressed in "degrees by Asker C." As illustrated in the attached copies of the Asker C durometer manuals, one of ordinary skill in the art would have been able to obtain the correct Model C durometer and properly use the device to take accurate and repeatable measurements.

In view of the above comments, Applicants respectfully submit that claims 18 and 19 are fully enabled by the specification. Reconsideration and withdrawal of the rejection are respectfully requested.

IV. <u>Rejection under §103</u>

The Office Action rejects claims 7-10 under 35 U.S.C. §103(a) over U.S. Patent No. 5,250,382 to Shimojo et al. ("Shimojo") combined with U.S. Patent No. 5,079,123 to Nanya et al. ("Nanya"). Applicants respectfully traverse the rejection.

The Office Action cites Shimojo for teaching a two-component developer including a binder resin having a domain-matrix structure and comprising a domain resin and a matrix resin, and points specifically to Example 31. The Office Action concludes that it is reasonable to presume that Shimojo's toner has the molecular weight requirements recited in claim 7 and places the burden on Applicants to prove otherwise. Applicants respectfully

disagree with this assertion and submit the following remarks and evidence in support of their position.

As shown in the attached Declaration, based on the molecular weight and weight ratios of the developer described in Example 30 of Shimojo, the developer does not meet the claimed values for the differential molecular weight distribution of 5×10^3 or 1×10^5. The results show that in Shimojo Example 30 the ratio of differential molecular weight distribution of 5×10^3 is 0.569. In addition, the Declaration also shows that binder resin 28, and comparable binder resins 39 and 40 of Shimojo, would also fail to meet the claimed values for the differential molecular weight distribution of 5×10^3 as claimed. The differential molecular weight distribution of 5×10^3 would be even greater than that observed in the developer of Example 30 because the toners including binder resins 28, 39, and 40 would have molecular weights that are greater than that of Example 30.

Contrary to the Office Action's conclusion, Shimojo's toner would not have the molecular weight requirements recited in claim 7. Since Shimojo does not teach or suggest the toner as claimed, claim 7, and claims 8-10 dependent thereon, would not have been obvious under §103. Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection.

The Office Action acknowledges that Shimojo fails to disclose a toner having the molecular weight by GPC properties of the THF dissolved components of the present invention. However, Nanya fails to remedy the deficiencies of Shimojo. Moreover, the Office Action does not rely on Nanya for teaching or suggesting such molecular weight properties.

Thus, Applicants submit that Shimojo and Nanya, either alone or in combination, fail to teach or suggest the present invention. Claims 7-10 would not have been obvious over the

cited references. Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection.

V. Conclusion

In view of the foregoing amendments and remarks, Applicants submit that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 1 - 20 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in better condition for allowance, the Examiner is invited to contact Applicants' undersigned representative at the telephone number set forth below.

Respectfully submitted,

James A. Oliff
Registration No. 27,075

H. James Voeller
Registration No. 48,015

JAO:HJV/hs
Attachment:
- Appendix
- Request for Examiner Interview
- Declaration Under 37 C.F.R. §1.132
- References (2)
- Petition for Extension of Time

Date: April 4, 2003

OLIFF & BERRIDGE, PLC
P.O. Box 19928
Alexandria, Virginia 22320
Telephone: (703) 836-6400

DEPOSIT ACCOUNT USE AUTHORIZATION
Please grant any extension necessary for entry;
Charge any fee due to our Deposit Account No. 15-0461

APPENDIX

Changes to Specification:

Page 6, line 24 to page 7, line 6:

The 4^{th} aspect of the invention is an image-forming process including a latent image-forming step of forming an electrostatic latent image on a latent image holding member, a developing step of forming a toner image by developing the electrostatic latent image with a toner, a transfer step of transferring the toner image onto a transfer material to form a transfer image, and a fixing step of fixing the transferred image using a fixing apparatus comprising, for example, a heat roller and a press roller. The toner is that described in the aspect 1 or 2 above, the surfaces of the heat roller and the press roller are formed of a releasing resin such as, for example, a fluorine resin, and a releasing liquid is not substantially supplied to the surfaces.

Page 8, lines 8-10:

The 11^{th} aspect of the invention is the image-forming process described in the aspect 4 described above. When the toner amount on the recording paper is 0.50 mg/cm^2 and the glossiness (75 degree gloss) is from 40 to 60, and preferably 40 to 50.

Page 23, line 21 to page 24, line 3:

The image-forming process of the invention is an image-forming process including a latent image-forming step of forming an electrostatic latent image on a latent image holding member, a developing step of forming a toner image by developing the electrostatic latent image with a toner, a transfer step of transferring the toner image onto a transfer material to form a transfer image, and a fixing step of fixing the transfer image using a fixing apparatus comprising, for example, a heat roller and a press roller, wherein the above-described toner is the toner of the invention, the surfaces of the above-described heat roller and press roller are formed with a releasing resin such as, for example, a fluorine resin, and a releasing liquid is not substantially supplied to the surfaces.

Page 26, lines 5-18:

In the image-forming process of the invention, fixed images having a high glossiness can be obtained. Because the glossiness of a fixed image largely depends upon the structure of the fixing apparatus and the fixing condition, it is difficult to obtain a high gloss by satisfying all the conditions but in the present invention, a high glossiness can be obtained by the following conditions. That is, in the invention, in the state of substantially not supplying a releasing liquid to the surface of the heat roller, using a recording paper having a basis weight of from 50 to 120 g/m^2 as the recording material, and when the toner image is fixed to the recording paper by heat-pressing under the conditions that the surface temperatures of the heat roller and the press roller are from 150 to 180°C and the peripheral speed of the heat roller and the press roller is from 70 to 120 mm/second, a fixed image having a glossiness (75 degree gloss) of from 40 to 60, preferably 40 to 50, can be formed when the toner carried amount formed on the recording paper is 0.50 mg/cm^2. The image having such a high glossiness is suitable for a pictorial image and an OHP image and gives a fill color image having a high quality.

Page 36, in the Table:

Table 6

	Contents of Wax	Melting Point (°C)	Melt Viscosity at 110°C (mPa•s)	
Wax ~~A~~C	Granular purified carnauba wax	83	50	
Wax ~~B~~D	Microcrystalline wax	85	110	
Wax ~~C~~E	Heptatriacontanole oxalate	103	150	

Page 45, line 20 to page 46, line 9:

In the toner of Comparative Example 6, the value of the differential molecular weight distribution of the above-described molecular weight of 5 x 10^3 is not larger than 0.55%, but

because the above-described molecular weight is also distributed in the range of at least 1×10^6, and the value of the differential molecular weight distribution of the above-described molecular weight of ~~1×10^6~~ 1×10^5 is larger than 0.15, although the anti-offset property may be satisfied, the OHP transparency is insufficient and the low-temperature fixing property cannot be satisfied.

In the toner of Comparative Example 7, the value of the differential molecular weight distribution of the above-described molecular weight of 5×10^3 is not larger than 0.55%, but because the above-described molecular weight is also distributed in the range of at least 1×10^6, and the value of the differential molecular weight distribution of the above-described molecular weight of ~~1×10^6~~ 1×10^5 is larger than 0.15 and also the melt viscosity of the wax is too high, although the anti-offset property may be satisfied, the OHP transparency and the low-temperature fixing property cannot be satisfied.

Changes to Claims:

The following is a marked-up version of the amended claims:

13. (Amended) An image forming process comprising a step of forming an electrostatic latent image on a latent image holding member, a step of forming a toner image by developing the electrostatic latent image with a toner, a step of transferring the toner image onto a transfer material to form a transfer image, and a step of fixing the transferred image using a fixing apparatus comprising at least one roller, wherein the toner is the electrostatic latent developing toner described in claim 1, ~~the~~and wherein a surface layer of the ~~fixing apparatus having~~at least one roller comprises a releasing resin, and a releasing liquid is not substantially supplied to the surface layer of the at least one roller~~thereof~~.

15. (Amended) The image forming process according to claim 13, wherein when an amount of the toner image formed on the ~~recording~~ transfer material before fixing is 0.50 mg/cm², the toner image ~~having~~ has a glossiness (75 degree gloss) of from 40 to 60.

16. (Amended) The image forming process according to claim 13, wherein the fixing apparatus comprises~~having~~ a heat roller and a pressure roller~~, and~~ the heat roller having a surface temperature of from 150 to 180°C.

17. (Amended) The image forming process according to claim 13, wherein the fixing apparatus ~~having~~comprises a heat roller and a pressure roller~~, and~~ the heat roller and the pressure roller each having a peripheral transferring speed of from 70 to 120 mm/seconds.

ASKER

RUBBER HARDNESS TESTER (DUROMETER)

INSTRUCTION MANUAL

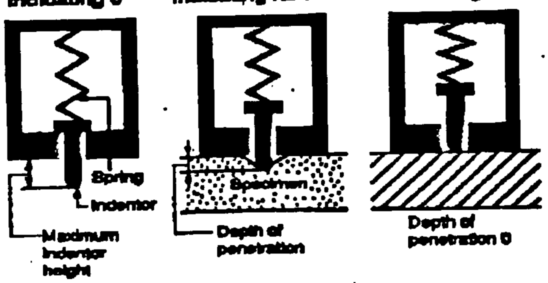
KOBUNSHI KEIKI CO., LTD.

Thank you for purchasing the ASKER Rubber Hardness Tester. This hardness tester which has thus far been known as a machine for measuring the hardness of rubbers, etcs. (also called as a spring type hardness tester or durometer) is easy to handle and permits jiffy measurement and is therefore widely used but for exact measurement, care must be taken for a number of points. This instruction manual gives explanation on how to correctly use this hardness tester together with the necessary precautions to be taken. (The paragraph 2. "How to Measure Hardness" described in this manual is not applicable to the Hardness Tester Type F. A separate instruction manual for the method of measuring hardness with the Type F is available.)

1. How Hardness is Measured

This hardness tester is designed to measure the hardness of a test specimen from the "depth of penetration" of the indentor in the state of the balance between the resistance force of the specimen and the force of a spring (Fig. b) when the indentor of the predetermined geometry is pressed to the surface of the specimen by the force of the spring and the specimen is indented. The hardness tester is equipped with the indicating mechanism which reads the depth of penetration from the scale graduating, at equal intervals, the depth of penetration from the depth of penetration =maximum height of the indentor (namely the displacement of the indentor is zero-Fig. a) for 0 degrees and zero depth of penetration (Fig. c) for 100 degrees. The load applied from the indentor to the specimen is not constant as the force by the deflection of the spring is used, thus the load changes linearly between zero degrees to 100 degrees.

Fig. a Indicating 0° | Fig. b Indicating hardness | Fig. c Indicating 100°



A number of kinds of hardness testers are specified in the requirements specified in JIS, ASTM, etc. and the details are determined with respect to the "shape of indentor", "the force to be applied to the indentor by spring", etc. for the respective hardness testers.

We manufacture various kinds of hardness testers in addition to the hardness testers mentioned above so that the hardness of a wide range of materials can be measured.

AVAILABLE TYPES OF ASKER RUBBER HARDNESS TESTERS

Model	Principal Standards	Indentor Design [mm]		Spring Load [mN(g)]		Measuring objects	Size & Shape of the presser foot[mm]
		Height	Shape	0 Degree	100 Degree		
A(AL)	JIS K 6253 JIS K 7215 ASTM D 2240 ISO 7619 ISO 868 (Durometer Type A)	2.50	35-Deg. Truncated Cone 0.79	550 (56)	8050 (821)	Normal rubber (for recessed part)	44X18 (rectangular)
D	JIS K 6253 JIS K 7215 ASTM D 2240 ISO 7619 ISO 868 (Durometer Type D)		30-Deg. Cone Tip Radius 0.1	0 (0)	44450 (4533)	Hard rubber	
E	JIS K 6253 (Durometer Type E)		2.50 Radial Hemisphere	550 (56)	8050 (821)	Soft and cellular rubber	
JA	JIS K 6301 (Type A)	2.54	35-Deg. Truncated Cone 0.79	539 (55)	8379 (855)	Normal rubber	
B	ASTM D 2240 (Durometer Type B)	2.50	30-Deg. Cone Tip Radius 0.1	550 (56)	8050 (821)	Semi-hard rubber	
ASKER C	JIS K 7312 SRIS 0101	2.54	5.08 Diameter Hemisphere	539 (55)	8379 (855)	Soft and cellular rubber, textile windings	
ASKER C2	ASKER C2			539 (55)	4460 (455)	Soft sponge	
ASKER CS	ASKER CS		10 Diameter Circular Cylinder	980 (100)	44100 (4500)	Polystyrene foam	50 Diameter (Circular)
ASKER FP	ASKER FP		15 Diameter Circular Cylinder	980 (100)	1960 (200)	Powder puff	50X37 (Oval)
ASKER F	ASKER F		25.2 Diameter Circular Cylinder	539 (55)	4460 (455)	Foam rubber, plastic foam	80 Diameter (Circular)

2. How to Measure Hardness

You hold the tester perpendicularly with both hands, press the pressor foot (the surface from which the indentor xtends) of the tester to the surface of the test specimen and read the position of the pointer on the scale plate at that time (or a few seconds after) from the front of the tester. The measurement is basically as simple as above but the following precautions must be observed to improve the accuracy of measurement.

1) The specimen must be free from mechanical stresses and must have the smooth surface free from undulation, waviness, etc. (Undulations of 0.025 mm lead possibly to an indication error of maximum 1 degree.) The measuring surface of the specimen is preferably larger than the size of the pressor foot of the tester (18 × 44 mm; however, a diatester 12 mm with the type AL and diatester 50 mm with the type CS). The thickness of the specimen must be at least 6 mm or larger with the types JC, D and CS and be at least 12 mm or larger with other types. The specimen thinner than these is measured in some cases after the specimens are laminated up to these thicknesses for the sake of conveniences but care must be exercised in such a case not to leave air layers between the respective layers of the specimen.
   The measurement of the specimen that does not meet the above-mentioned conditions is also possible but the measured value in this case should be used only as the data for comparison of hardness under the determined constant conditions (the thickness and shape of the specimen, the condition of the object with which the specimen contacts, etc.)
2) The force for pressing the tester to the specimen varies with the types of the testers.

   Type A, AL, E, JA, JAL, B, C and Ca:
   Lightly press the pressor foot to the specimen surface under the force of 1 to 1.5 kg with the feel of providing a uniform contact between the pressor foot and the sample surface.
   Be careful with the soft specimen as the hardness measured will be higher than the true hardness if the specimen is pressed with the excessive force.

   Type D, JC, and CS:
   With these testers, the specimen is required to be pressed strongly under the force of over 5 kg as the springs of large force are used. An error may be produced from the insufficient pressing force particularly with the hard specimen.
3) The tester may fail to make correct indication if the tester is inclined forward or backward or is pressed to the specimen in the state of holding the tester by one hand or when the pressing direction deviates considerably from the perpendicular axis of the specimen.
4) If the same area of the specimen is measured continuously, the indication will decrease gradually. This should be avoided by making measurement after lapse of suitable tim or measuring the hardness at the point apart by more than 6 mm from the point previously measured, The indication will be lower in the part near the periphery of the specimen as the resistance of the specimen to the indentor is lower in this part. The measurement must therefore be made at the point inner by more than 12 mm from the periphery of the specimen.
5) The high speed of pressing the tester to the specimen results in a higher indication and the low speed in a lower indication and therefore the tester must be pressed to the sample at the constant speed as far as possible. The measurement value to be obtained varies also with whether the position of the pointer is read at the maximum value, is read at the value right after pressing or is read upon lapse of some seconds after pressing. Thus, these conditions must be determined constant. These conditions are particularly carefully noted for any material with which stress relaxation appears (such a material with which the indication falls right after the indentor is pressed to the material surface). (A maximum pointer type hardness tester is also available from us for sure reading of the maximum value or for measurement when the reading from the front of the tester is difficult.)

3. Maintenance

The following precautions must be taken for the daily use and maintenance of this tester:

1) Keep the tester free from shock and impact during handling.
2) Use or store the hardness tester desirably in a place where moisture is low and less dust and oil vapor exist. Do not oil any part of the tester.
3) When reusing the tester after long storage, make "idle pressing" about 20 times prior to the measurement.
4) Before use, be sure to confirm that the pressor foot and the indentor are free from any deposit and that the indentor foot is free from any damage that may impair the hardness measurement.

4. Periodic Inspection

The hardness tester requires periodic inspections according to the frequencies of its use. If the tester is frequently used every day, make inspection at least once every three months by the procedures shown in the table below. An "indentor height gage" is manufactured by us for use as an instrument for inspections of 2, and 4 shown in the table and a "load checker" is also manufactured by us for inspection of 5. These implements will make your inspection easier and more reliable. The hardness tester which is rejected as a result of the inspection requires adjustment and repair and must therefore be returned to us.

PERIODIC INSPECTION OF ASKER RUBBER HARDNESS TESTER

Sequence	What to Inspect	How to Inspect	Remarks
1	If the shape of indentor is normal.	Check by using a profile projector, etc. to see if the size and shape of the indentor are within the specified permissible range.	This check can be omitted if the indentor is considered to have no wear and deformation.
2	If the pointer is correctly installed to the pointer shaft.	Substantially press the presser foot to a smooth surface and check if the pointer indicates 100±1.	
3	If the maximum indentor height is correct.	Check if the pointer indicates 0±1 when the displacement of the indenter is zero.	
4	If the indicating mechanism indicates the displacement of indentor correctly.	Apply the displacement to each indication to the indentor and check if the pointer indicates the specified value ±1.	Usually check at 3 points, 2, 50 and 100.
5	If the load characteristic of the spring is correct.	Apply the load corresponding to each indication to the tip of the indentor and check if the pointer indicates the specified value ±1.	Usually check at 3 points, 25, 50, 75.

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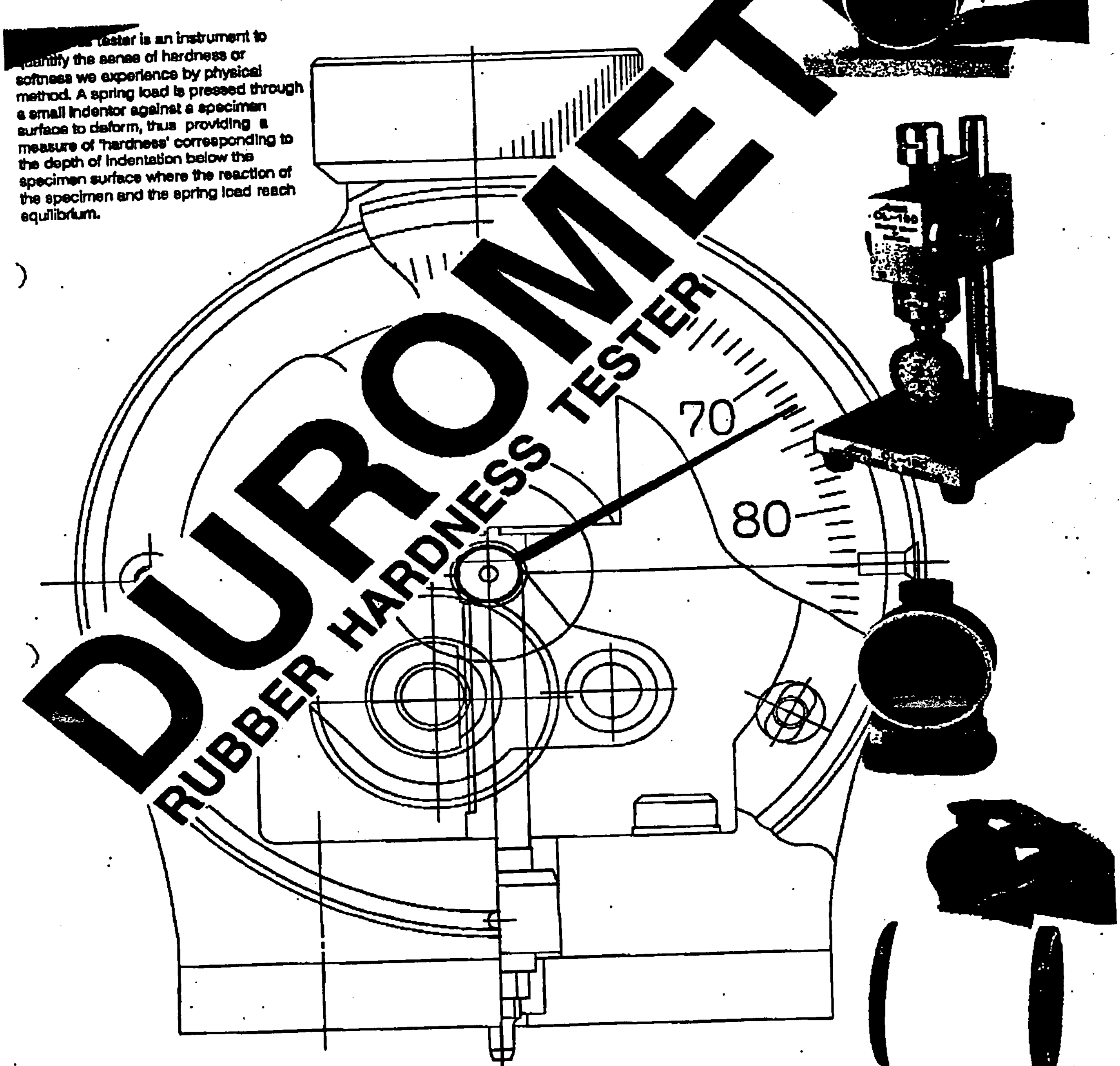
ASKER

HARDNESS TESTER FOR RUBBER AND PLASTICS

[redacted] tester is an instrument to quantify the sense of hardness or softness we experience by physical method. A spring load is pressed through a small indentor against a specimen surface to deform, thus providing a measure of 'hardness' corresponding to the depth of indentation below the specimen surface where the reaction of the specimen and the spring load reach equilibrium.



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LIST OF ASKER RUBBER HARDNESS TESTERS

One of the most important steps in using a rubber hardness tester is to select the optimum type. There are various types of rubber hardness testers available based on different standards applied to a wide variety of subjects to be measured.

Among them the most popular models for rubber materials are JIS K 6253-specified Type A Durometer(ASKER Model A) and JIS K 6301-specified Type A Hardness Tester(ASKER Model JA).

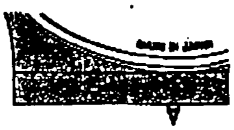
Other typical models include ASTM D 2240-specified Type D Durometer(ASKER Model D) for hard rubber and the ASKER Model C for soft rubber or flexible cellular materials.

On the other hand, ASTM D 2240-specified Type A and D hardness tester will be increasingly used for international trade because of conforming with ISO.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
A(AL)	JIS K 6253 JIS K 7215 ASTM D 2240 ISO 7619 ISO 868 (Durometer Type A)	2.50	35-Deg. Truncated Cone 0.79	550 (56)	8050 (821)	44×18 (Rectangular)	Width 57 Depth 30 Height 78	200
D	JIS K 6253 JIS K 7215 ASTM D 2240 ISO 7619 ISO 868 (Durometer Type D)		30-Deg. Cone Tip Radius 0.1	0 (0)	44450 (4533)			
E	JIS K 6253 (Durometer Type E)		2.5 Radial Hemisphere	550 (56)	8050 (821)			
JA	JIS K 6301 (Type A)	2.54	35-Deg. Truncated Cone 0.79	539 (55)	8379 (855)			
B	ASTM D 2240 (Durometer Type B)	2.50	30-Deg. Cone Tip Radius 0.1	550 (56)	8050 (821)			
ASKER C	JIS K 7312 SRIS 0101	2.54	5.08 Diameter Hemisphere	539 (55)	8379 (855)			
ASKER C2	ASKER C2			539 (55)	4460 (455)			
ASKER CS	ASKER CS		10 Diameter Circular Cylinder	980 (100)	44100 (4500)	50 Diameter (Circular)	50×50×78	250
ASKER FP	ASKER FP		15 Diameter Circular Cylinder	980 (100)	1960 (200)	50×87 (Oval)	50×87×81	300
ASKER F	ASKER F		25.2 Diameter Circular Cylinder	539 (55)	4460 (455)	80 Diameter (Circular)	80×80×81	500

● Indentor Design

Conical Design



Cone point type.
Model B and D have this type.
Measuring objects:
Hard rubber and plastics

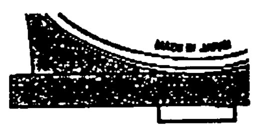
Truncated Cone Design

Flat point type.
Model A and JA have this type.
Measuring objects:
Normal rubber

Hemispherical Design

Hemispherical point featuring larger contact area. ASKER Model C is included in this type.
Measuring objects:
Soft rubber and sponge

Cylindrical Design

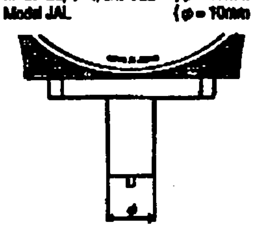


This type allows an extended specimen surface area to be pushed. Model F, FP, and CS have this type.
Measuring objects:
Urethane foam, sponge, and polystyrene foam

● Long Presser Foot Type

This features a longer presser foot, allowing measurement of narrow measurement objects of those having recessed sections.

Model AL, DL, and BL (φ = 12mm)
Model EL, C1L, and C2L (φ = 16mm)
Model JAL (φ = 10mm)



ASKER Model F
- Urethane foam
- Sponge
- Non-woven fabric

ASKER Model FP
- Powder puff

Exclusive type for foam materials, allowing measurement by placing the tester on the object of measurement.
In addition to Model F, Model FP is available for powder puff.

ASKER Model CS
- Polystyrene foam

This features larger indentor and a more strong spring compared to ASKER Model C, thereby making it more suitable for polystyrene foam.

ASKER Model C
ASKER Model C2
- Soft rubber
- Sponge
- Textile windings
- Rolled films
- Potter's clay

ASKER Model C is intended for hardness measurement of soft rubber, sponge, textile windings, rolled films, potter's clay, and other such soft materials.
For even softer materials, Model C2 is available.

DESCRIPTION OF SPRING TYPE RUBBER HARDNESS TESTERS(DUROMETERS)

Measurement of hardness is one of the essential factors for determining characteristics of various rubber, elastomers, and plastic products.

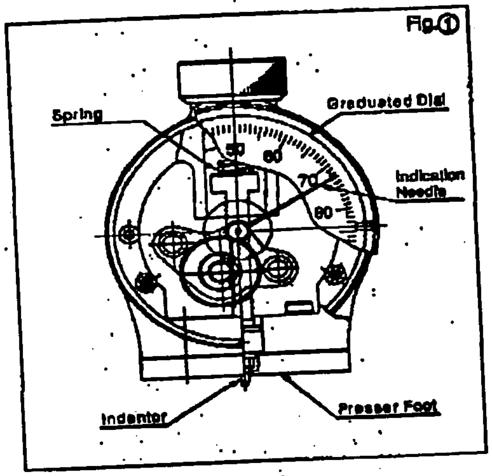
Featuring portable design, ease and simplicity of operation, and nondestructive measurement, the spring-type rubber testers (durometers)have been in widespread use.

The operational principle is shown in Fig.1.
An indentor is pressed against the surface of a specimen with the force of a spring load and the indented depth of the point is measured when the reaction of the specimen and the spring load reach equilibrium, thus providing a measure of hardness.

As shown in Fig.2, hardness is indicated on a dial scale of equal divisions from 0 to 100, called hardness value.

Expression of hardness is often specified by relative standards. For details, refer to the table entitled; 'Various Hardness Test Methods, Hardness Testers Used, and Hardness Data Expression According to Different Standards' listed later in this brochure.

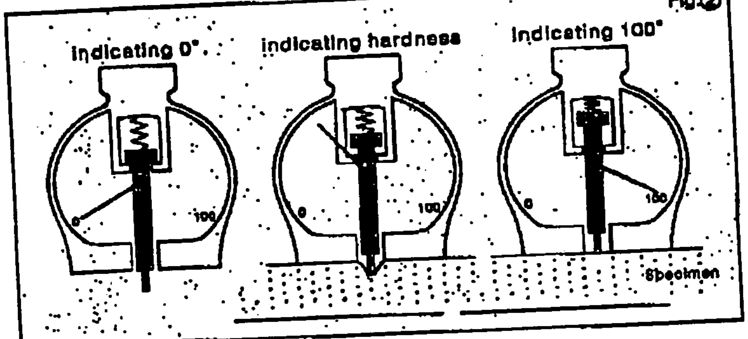
Fig.①



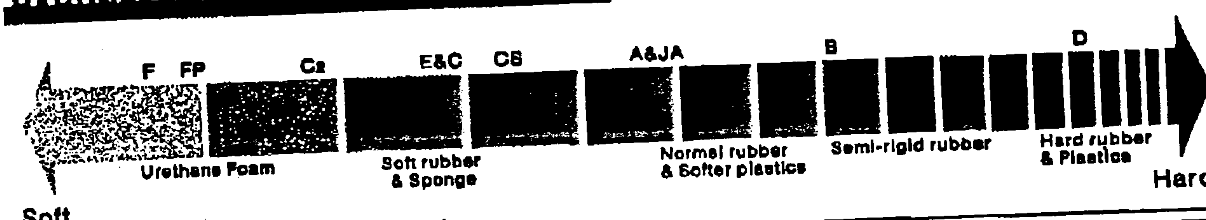
Notes for Measuring Hardness

(1) Bear in mind that measured results are influential with ambient temperature and humidity.
(2) For best results, test specimen must have smooth surfaces without any irregularity, warp, or waviness.
(3) When measuring at multiple points on one specimen, allow an minimum interval of 6mm between measurement points. In addition, ensure that measurement points are at least 12mm from the edges of the specimen, as specified in domestic and international standards.
(4) Measured results are influential with the speed of pressing of indentor against a specimen. For optimum measured results pay attention to use a constant point pressing speed.

Fig.②



HARDNESS TESTER SELECTION CHART



ASKER Model E
- Soft rubber
- Sponge

This model is defined as 'Durometer Type E' as described in JIS K 6253.
Similar to ASKER Model C, available for soft and cellular rubber.

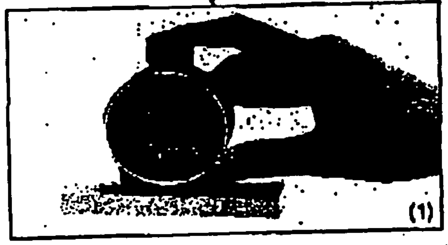
ASKER Model A
- Normal rubber

The most popular type for normal rubber all over the world, standardized in JIS K 6253, ISO 7619, ASTM D 2240, etc.

ASKER Model JA
- Normal rubber

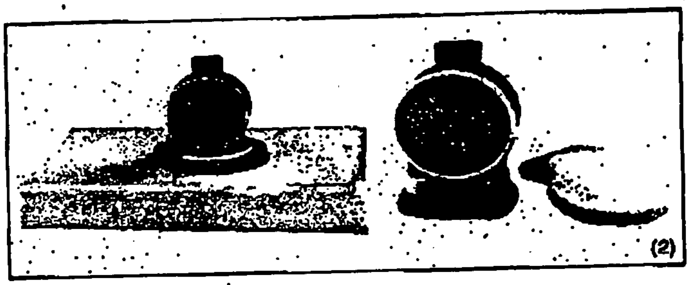
A hardness tester which conforms with the former JIS K 6301. So far, one of the most popular types in Japan, but has recently been gradually replaced with the ISO-specified Type A.

AVAILABLE HARDNESS MEASURING METHODS



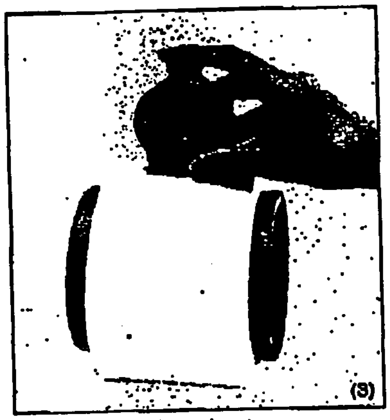
(1)

(1) For optimum measured results, press a hardness tester vertically onto the surface of a horizontally oriented specimen, using a constant load.
Keep in mind that tester must be pressed against the specimen with both hands (though the photo shows use of a single hand) in a proper position, aligning the graduated dial of the tester with the inspectors eyes.
The instructions, "Hold a tester vertically" and "Place the test specimen on a flat surface," appear in applicable standards.



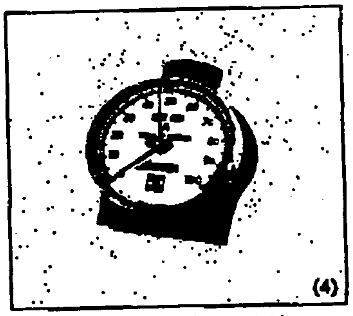
(2)

(2) The photo shows measurement by ASKER Models F(left) and FP(right). Gently place the tester vertically onto a specimen and take a reading.



(3)

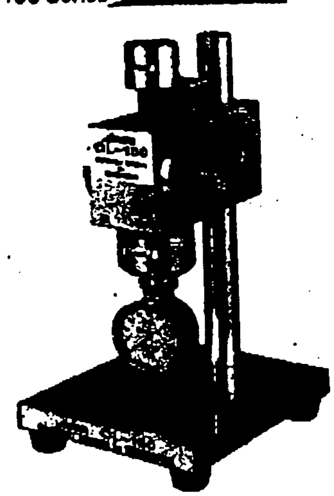
(3) The photo shows hardness measurement of rolled threads using ASKER Model C.
Hardness of rolls may be measured by gently pressing the tester against the measuring surface.
It also allows measurement of film rolls.



(4)

(4) For those samples exhibiting stress relaxation* or when it is difficult to take readings from the front, the two-pointer type is useful because there is a halt of the peak value-indicating pointer.(The two-pointer system is optional.)
*Those materials for which a reading decreases immediately after the indentor is pressed against the surface.

Constant Loader for Durometer CL-150 Series

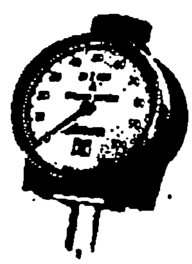


A hardness tester may be used in combination with a constant loader providing a consistent pressing condition against specimens so as to allow steady and stable hardness measurement. This combined use eliminates deviations in measure results caused by differences in operating skills among individual inspectors.

Model	ASKER Durometer	Measuring Load
CL-150L	A, JA, E, C	1000g, 1250g
CL-150H	D, JC	5000g
CL-150M	Any type of ASKER Durometers	1000g, 1250g, 5000g

ASKER Model AL

- Normal rubber
  (Specifically for measurement of recessed surfaces)



Especially useful for recessed and/or smaller measuring areas. In addition to the standard Model AL, long presser foot types are available for another Model applications.

ASKER Model B

- Semi-rigid rubber
- Green ceramics

It uses the same spring load used in ASKER Model A. It adopts a conical indentor similar to that of Model D, so as to be applicable to harder measuring objects than can be measured by Model A.

ASKER Model D

- Hard rubber
- Plastics

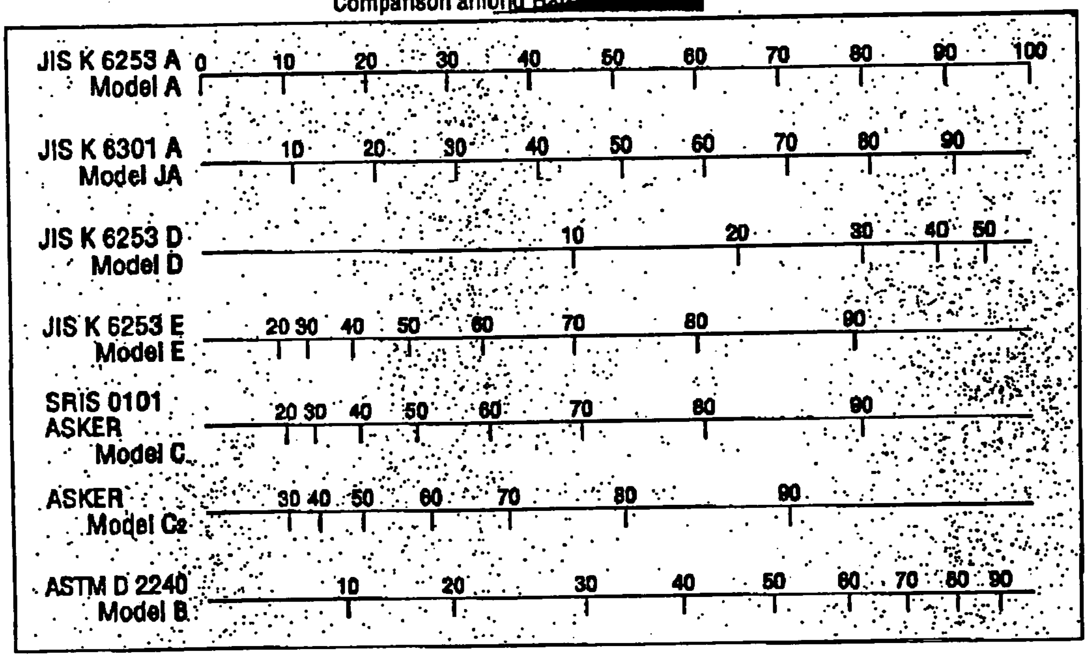
The most popular type for hard rubber all over the world, standardized in JIS K 6253, ISO 7619, ASTM D 2240, etc.

ASKER

COMPARISON AMONG VARIOUS HARDNESS DATA

The table below is intended to provide a guideline for comparison of hardness values, but not for conversion among different hardness testers.
The relationship among hardness value obtained using different types of hardness testers cannot be easily and simply determined.
This is because hardness depends on a wide variety of factors such as sample composition, vulcanization conditions, viscoelasticity, dimensions of shape, and measuring temperature and humidity.

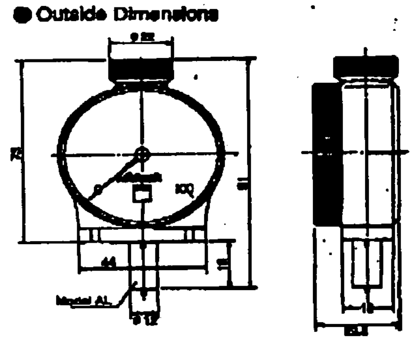
Comparison among Hard



VARIOUS HARDNESS TEST METHODS, HARDNESS TESTERS USED, AND HARDNESS DATA EXPRESSION ACCORDING TO DIFFERENT STANDARDS

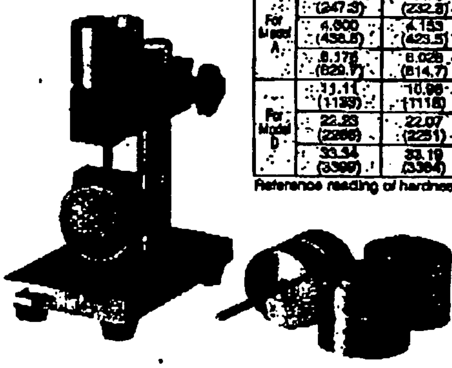
JIS K 6253-1997 Hardness Testing Methods for Vulcanized Rubber	Durometer hardness test	Type A durometer	A 50/S
		Type D durometer	D 50/S
		Type E durometer	E 50/S
JIS K 7215-1986 Testing Methods for Durometer Hardness of Plastics	Durometer hardness test	Type A durometer	HDA 50
		Type D durometer	HDD 50
ASTM D 2240-97 Standard Test Method for Rubber Property-Durometer Hardness	Durometer hardness test	Type A durometer	A/50/1
		Type D durometer	D/50/1
ISO 7619-1997(E) Rubber-Determination of indentation hardness by means of pocket hardness meters	Durometer hardness test	Type A durometer	A 50/1 or A/50
		Type D durometer	D 50/1 or D/50
ISO 868-1985(E) Plastics-Determination of indentation hardness by means of a durometer	Durometer hardness test	Type A durometer	A/50/1
		Type D durometer	D/50/1
JIS K 6301-1998 Physical Testing Methods for Vulcanized Rubber	Spring type hardness test	Type A	50Hs JIS A
		Type C	50Hs JIS C
SRIS 0101-1968 Physical Testing Method for Expanded Rubber	Spring type hardness test	Spring type hardness tester (ASKER C)	Measured hardness and used tester type will be reported.

● Outside Dimensions



Load Tester for [redacted]

A load tester to check the characteristics of spring loads applied by hardness testers. With the force of weights it applies a specified reference load onto the indentor to check for correct correspondence among hardness reading of 25, 50 and 75 and relative spring loads. Different types of hardness testers provide different spring loads. Refer to the table below for selection of the optimum type.



	Testing Load N (g)	Actual Weight load N (g)	Hardness Tester Model	Hardness Tester Reference Reading	Applicable Hardness Tester Model	Applicable Hardness Tester Reference Reading
For Model A	2.425 (247.3)	2.278 (232.3)	A B E	25.0	JA C (JAL)	24.0 (24.5)
	4.300 (438.5)	4.153 (423.5)		50.0		47.9 (48.4)
	6.176 (629.7)	6.028 (614.7)		75.0		71.8 (72.3)
For Model D	11.11 (1133)	10.96 (1118)	D	25.0	JC CS	23.6
	22.23 (2266)	22.07 (2251)		50.0		49.2
	33.34 (3399)	33.19 (3384)		75.0		75.0

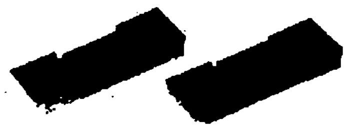
Reference reading of hardness tester correspond to test load.

INSPECTION OF HARDNESS TESTERS

A rubber hardness tester may be identified as functioning correctly through tests using an indentor extension tester to check the height of the indentor point and a load tester to check the spring load.

Indentor Extension Tester for [redacted]

A gage to check the extension of an indentor on a hardness tester and the reading indicator mechanism. Applicable standards specify two extension, 2.50mm and 2.54mm for an indentor and the indentor testers are available for two models A and JA corresponding to the respective extension. Each indentor extension tester set is complete with two gages, one for hardness value of 50 and the other for hardness value of 2.



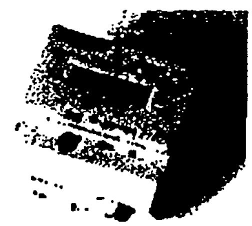
	Hardness Tester	Max.Height Indentor (mm)	Display of Extension Tester	
			50 DEG	2 DEG
Model A	A, B, D, E	2.50	H-1.250	H-2.450
Model JA	JA(JAL),C, JC, CS	2.54	H-1.270	H-2.489

OTHER AVAILABLE HARDNESS TESTERS

Digital Hardness Tes[redacted] for Rubb[redacted]

Features peak holding and timer holding capabilities, as well as statistical processing in combination with an optional printer.

<Developed jointly with The Yokohama Rubber Co.,Ltd.>



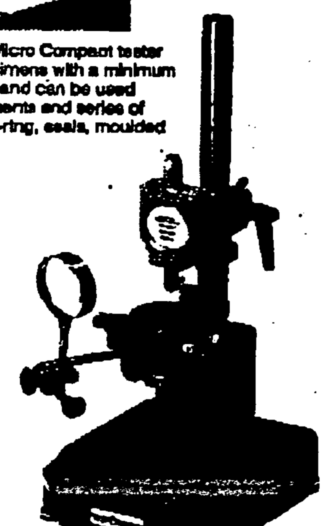
Micro Hardness Tes[redacted]

Developed specifically for hardness measurement of small rubber parts and thin sheets which could not be properly measured by previously existing hardness testers. Designed at allow full-automatic measurement, it is not affected by differences in operating skills among individual inspectors and it takes only 3 seconds or so to provide measured data for each sample, with an additional feature of statistical processing.

These materials may be correctly measured for their hardness.

IRHD Micro Co[redacted]

This Bareiss IRHD Micro Compact tester is available for specimens with a minimum thickness of 0.5mm and can be used for single measurements and series of measurements on O-ring, seals, moulded parts.



Advantages

- The firing driving to the starting position of the measurement 100 is no longer necessary.
- The supporting table together with the sample is positioned upwards exactly by the use of the quick-adjustment lever, which has to be adjusted only one time.
- A two lined LC-display informs about the automatic running down of the measuring run and shows the result afterwards.

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